An Introduction to The Algebra Revolution

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An Introduction to *The Algebra Revolution*

Abstract

*The Algebra Revolution: How Spreadsheets Eliminate Algebra 1 to Transform Education* argues that Algebra 1 can be eliminated by teaching mathematics through spreadsheets. Such a change would eliminate the greatest roadblock to student achievement.

Keywords
quantitative literacy, mathematics curriculum, spreadsheets

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Cover Page Footnote
Art Bardige is a curriculum developer and Trustee of Lesley University. Having founded and built several interactive curriculum platforms, he is currently CEO of What if Math.

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Ask anyone, “What math course do you remember?” The answer I hear most often and without hesitation is Algebra 1. Some smile saying it was the first math course they found fun and interesting. Most squinch their face as they remember its trauma. Research bears out the unfortunate reality of this pained reaction.

Algebra 1, for better or worse, was and remains the essential center of our math curriculum determining our students’ future in one way or another: their middle school track, their high school courses, the AP exams they may prepare for. It is the focus of their 10th grade math Common Core tests to receive a high school diploma. And for all too many, their college entrance readiness score likely will force them to waste time and money on “developmental” math 095 courses. Perhaps the saddest Algebra 1 result for most students will be the label they give themselves: smart or dumb, STEM career capable or never, abstract thinkers or not, and get math mostly or not.

We hope our students make life choices for positive reasons, but all too many cannot. They are forced to choose courses, schools, and careers because they couldn’t do Algebra 1! It is a life-determinative course.

Algebra 1, as a subject to be studied, entered education in the year 1202 when Leonardo of Pisa started teaching it to Pisan merchants to support their medieval trade. The rise of city-states in the Middle Ages, each with its own monetary and measuring systems required proportional reasoning and algebraic problem solving. By the end of the 19th century, Algebra 1 was the crucial capstone high school mathematics courses for students who would become leaders and managers in the industrial revolution. In the 1960s, the Space Race forced it to become a universal requirement, and the tech revolution at the turn of the millennium brought the subject from high school down to 8th grade because of an increase in expectations for a college education. This acceleration in learning both in age and ability has turned Algebra 1 into our number one education problem.

I have spent a good part of my working life as a teacher, curriculum coordinator, software designer/developer, entrepreneur, and educational revolutionary seeking a solution to this problem. I finally recognized that the solution was not to transform Algebra 1, but to eliminate it!

My story began in the year 1979, when I met VisiCalc, the first spreadsheet. As I was learning to use this amazing new tool, I vividly remember trying to use it to solve a linear equation, to do Algebra 1. I could not. This thing worked with tables of values and not equations. A couple years later, I was elated when Dan Bricklin and Bob Frankston, VisiCalc’s inventors, published TK Solver to fix this obvious weakness. It solved equations, but it was a marketing failure because it was no longer needed. Even the inventors of VisiCalc failed to understand the spreadsheet revolution they started. Despite being a business spreadsheet power user, I too was paradigm constrained. I failed to imagine a spreadsheet revolution in education commensurate with the one in business.
When I started a new company to fix and solve the Algebra 1 problem as embodied in developmental math, I convinced myself and my investors that the technology transformation from paper textbooks to interactive screens was enough change for college faculty to accept, so I treated the content conservatively, the standard textbook syllabus they were delivering. Business failures teach us lessons if we listen. New technology can not only revolutionize the way content is delivered, it requires us to reimagine and reinvent the content itself. I had failed to make the connection between the business world and the education world that history should have taught me. I saw my business failure as a need for a reinvention.

I began by using spreadsheets as an application on which to build problem-solving content. I could experiment without raising a chunk of capital or building a large team of designers, coders, and content writers to invent a new application that would teach math. The spreadsheet had grown up in those years since VisiCalc. No, it still could not solve linear equations or factor a quadratic, but it could graph, handle large databases, add images, and it was free to students and substantially easier to use.

Playing with spreadsheets and math led me to finally ask, “What would the math curriculum look like if it were designed on and built for spreadsheets?”

I came to realize that spreadsheets, the ubiquitous tool of the modern workplace, are function machines. They are designed to work with functions and true variables (as in Algebra 2), not equations and unknowns (Algebra 1). These two algebra courses cover similar topics. Why do we need Algebra 1? Shouldn’t all of our students learn algebra and algebraic problem solving on spreadsheets to prepare them for their future and not our past? Eliminating Algebra 1 gives us room to use spreadsheets to teach data science, computer science, financial literacy, and real-world problem solving to all students. Spreadsheets will revolutionize the math our students learn, as well as the way they learn it (read more at https://whatifmath.org/). Eliminating Algebra 1 will transform not just math education, but all education. This is the story I tell in my new eBook, *The Algebra Revolution*. 
Excerpt from The Algebra Revolution: How Spreadsheets Eliminate Algebra to Transform Education

A Magic Wand

Our greatest human stories often begin as do-overs, fresh starts, blank slates. I think about them as magic wands. “If you had a magic wand . . .” I ask.

Each of us has had many such dreams about our work, our personal lives, and our institutions. I want to offer you a magic wand to apply to an institution, a particular one in this case our schools. Schools may well be our most important institutions, for we live and breathe them during our formative years and depend on them for shaping our work, family, and our lives for continuous learning. And we send our most precious resource to this institution to prepare them for their and thus for our future. If you had a magic wand to transform schools and schooling, what would it do?

I have such a magic wand for you to use. A transformational change that will cause all schools to be reinvented. I think you will find it a surprisingly simple change, relatively easy to implement but at the same time having extraordinarily broad implications. No, it is not a change you are likely to have heard about, like doing away with standardized tests. Nor an impossible one like magically transforming all teachers into great teachers. It is an eminently doable change that affects not only what we teach our students but how we teach them. It is a change that calls into question the very structure of our schools as well as the expectations we have for what we so lightly call learning. It is a change, a true transformation that will not only give our schools a fresh start but give all our kids opportunities for a fresh start anytime they are ready for one. For today, all too many of our students are locked into an educational pattern from

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the earliest grades that leaves them little chance for a fresh start or starts. Any magic wand worth its salt would provide many such opportunities.

Before I tell you more about the magic wand I will soon give you, I want you to dream, to imagine a school of the future, the near future; the school you would want to go to, the school you would want your children, all of our children, to go to. For, if the magic wand will give you the power to transform our schools, to take down an educational structure that traces back to medieval times, to achieve a true fresh start, then we have to first break free from its strictures if we are to imagine its future and rethink its purposes. I know, this task is far from easy. Our lives are permeated with our educational system’s standardized format and structure from the time we learn to crawl and spend a half of our waking days during our formative years living and working within it. In fact, one of the first questions we ask a child we just meet is, “What grade are you in?” because our place in the larger educational system defines us in so many ways.

I know I am asking you to do something difficult. So, take a few moments, and just dream. Take away the paper practice students spend so much time on. Take away the disciplines (Math, English, Social Studies, Science) as they are no longer relevant. Take away the grade-by-grade scope and sequence that defines the year-by-year “advancement” we expect students to march through. Take away the teacher as the center, the focus of the classroom. Indeed, take away the classroom as a standard format with 24 desks arranged in rows and columns. And, of course, take away the tests which have lost all their meaning and relevance, no longer representing an accurate assessment of the skills our kids will need when they join the workforce of their future. For we must think about schools as their future and not as our past.

Finally, please ask yourself, “What is the purpose of our schools?” Certainly, they serve a caretaking function, making sure our children are safe and secure while we are at work. And they certainly must serve a socialization function, bringing our youth into contact and collaboration with others to build the social cohesion so necessary for their future. But what is their educational function? Can you say in a word or two the essential skill or skills, like the old “reading, writing, ‘rithmetic,” that our kids should learn to prepare them for their future? Can you capture in a simple concept the essence of the meaning of education?

I ask you to consider these questions when I hand you this magic wand and show you how the system so fundamental to us, so iconic, can and likely will collapse in front of our eyes like a house of cards. Before I do, I will take you on a voyage of self-discovery and build you some of the scaffolding that led me to trust this magic wand.
Spreadsheets

Spreadsheets are today’s standard calculation tool, the ubiquitous tool for doing mathematics in business. Over the past 40+ years they have transformed the way we think about business, the way we do our research, even the way we keep tabs on our information. They are on just about every computer used for business in the broadest sense of that term. Like email and the Web they have changed the way we think. Yet spreadsheets are effectively invisible in our schools. We don’t find them used by students in K–12 schools except in rare instances. And few college classrooms utilize them even though these powerful, flexible programs, available on every computer, are free for students and teachers.

Any middle school student debater could easily argue the proposition that every high school graduate, let alone college student, should be proficient in using spreadsheets. Teachers know spreadsheets because most of them have at least a rudimentary experience using these tools to maintain student and home records. Administrators have to be generally competent in spreadsheets to manage budgets, schedules, etc. Even parents, who grew up with essentially the same math their kids are learning and believe that math to be canonical, often use spreadsheets in their work if not for organizing lists, home budgets, etc.

Likely the primary reason spreadsheets have played such a minimal role in our K–12 educational system is because they are antithetical to the concepts we focus on and the pedagogy we use. Spreadsheets are function machines. They are built on the concept of function, which uses a rule to transform an input into an output. They are not built to use or solve equations. Our math curriculum from kindergarten through Algebra 1 is focused totally on solving equations. Today, the concept of function is narrowly introduced in 8th grade, and for the most part relegated to the second half of Algebra 2 and Precalculus. It is an arena of math that despite its great importance most students barely cover.

From a pedagogical perspective, spreadsheets were a serious problem. They were calculating machines solving many, really most, of the arithmetic problems students do for homework. So, spreadsheets seem complex; they do not do math the way we teach it, they automatically do the arithmetic, and, until recently, were considered too difficult for most students. For our schools, therefore, the problem posed by spreadsheets is best solved by not even acknowledging their existence. It is no wonder they play such a small role today. Word processors and slideshow programs do not cause angst. We don’t have to hide these applications from our kids.